429666

EN-1029

DU PONT
ESTABLISHED 1802

E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED

WILMINGTON, DELAWARE 19898

ENGINEERING DEPARTMENT

CC: C.M. Hunter-Photo Prod.- Wilmington
M.L. Ward-Photo Prod.-Wilmington
J.E. Dickens-Photo Prod.-Exp. Sta.
W.G. Bottjer-Photo Prod.-Exp. Sta.
R.F. Bree-Photo Prod. - Newport
E.H. Kolb -Pigments - Newport
R.M. Haire - Pigments- Newport
G.A. Christian
A.C. Barlow
R.G. Kissell, Jr.
J.L. Parsons
RC 13/AEN~~SW~~

ORIGINAL (Red)

February 10, 1970

W. B. JENNINGS
PHOTO PRODUCTS DEPARTMENT
NEWPORT PLANT

PHOTO PRODUCTS DEPARTMENT - NEWPORT PLANT
SOLID WASTE DISPOSAL
MAGNETIC TAPE VENTURE - WASTE TAPE DISPOSAL

At your request, I have studied the problems associated with disposal of waste Crolyn® tape including the adequacy of present landfill methods and possible alternative disposal schemes. My findings, presented below, have been reviewed by A.C. Barlow and R.G. Kissell, Jr. (ESD Water Resources & Pollution Control) who are familiar with the Newport Plant.

SUMMARY AND CONCLUSIONS

1. Both hexavalent and trivalent chromium can be dissolved from the waste tape. Laboratory tests indicate that only a small percentage of the total tape chromium content will dissolve. The effect of long-term burial in a landfill site is unknown. Even if small amounts of chromium dissolve from the tape, the potential for ground water or stream pollution increases as larger quantities of tape are buried.

2. Carefully supervised and controlled burial of waste "Crolyn" tape at the present Newport Plant landfill site is the best alternative for the short term. Other disposal methods, preferably excluding landfill, must be developed if continued large scale production of waste tape is anticipated.

3. Borings have been made in the vicinity of the "Crolyn" tape disposal area and well points have been placed in some of these bore holes. The test borings indicate that the soil in the vicinity of the disposal area will retard migration of contaminants. However, care must be taken that tape is not buried in sandy water bearing lower layers. Water samples from the test wells show very low chromium levels which may be background concentrations.

AR200040

ORIGINAL (Red)

4. Drums containing CrO_2 or CrO_2 dispersion mixtures should not be buried at the Newport landfill site. Alternate disposal methods, such as contract disposal, or CrO_2 dust calcination for return to chromate producers should be considered.

RECOMMENDATIONS

1. Burial of the waste tape should be confined to the upper 6 or 7 feet of the landfill area. If a sandy water bearing strata is exposed in digging a new pit, this pit must not be used and should be refilled. Tape should be collected in and buried in large polyethylene bags as is presently done. Compaction of the tape to the greatest degree possible is recommended.

2. Water from the sample wells in the landfill area should be sampled quarterly and analyzed for chromate and total chromium content. Since original well samples were not large enough to get an accurate chromium analysis, new samples should be taken. These should be compared with samples from the Christina River and plant wells removed from the landfill site (this is presently underway).

3. If it is anticipated that large volumes of scrap tape will continue to be produced, alternate disposal schemes will have to be developed. I recommend that incineration and return of Cr_2O_3 ash to chromic acid manufacturers or other reuse schemes be considered rather than landfilling of large quantities of this material.

My detailed discussion is presented on the following pages.

If you have any questions or wish further assistance, please feel free to contact me.

ENGINEERING SERVICE DIVISION

P. A. Palmer

P. A. Palmer

PAP:lps
Attach.

ORIGINAL (Red)

DISCUSSION

Burial of waste "Crolyn" magnetic tape at the Newport Plant landfill site was begun in 1967. To date, the equivalent of 41,000 pounds of CrO_2 is buried at the Newport site and an additional 10,000 pounds is anticipated for 1970. These large quantities of landfilled chromium posed questions of the ultimate fate of the tape, the desirability of this method of disposal with respect to potential ground water and stream pollution, and the alternate disposal methods available. Each one of these aspects is reviewed below.

Tape Decomposition

Present knowledge of the decomposition of both CrO_2 and CrO_2 bearing tape are largely the result of Dr. W.D. Bottjer's work which I will summarize below.

Chromium dioxide (CrO_2) will slowly dissolve in water through the following disproportionation reaction:

$$3\ CrO_2 + H_2O \longrightarrow 2\ CrO(OH) + CrO_3$$

One-third of the chromium then would appear in the hexavalent form and the other two-thirds appear in the trivalent form. Early work on distilled water extraction of chromium dioxide powder showed a rate of decomposition of CrO_2 of approximately 0.03 wt %/hr at 25°C.(1) Other work indicated that a steady state concentration of about 100 mg/l CrO_4 might be attained at room temperature.(2) Elevated temperatures (65°C) might increase this to about 500 mg/l.

Early tests indicated that the tape would generate chromium approximately 100 times less rapidly than the oxide and that as little as 0.1% of the total chromium would be available for extraction. More recent studies of the buildup of CrO_3 in distilled water in contact with various tape formulations have given CrO_3 concentrations of 0.5 - 1.3 ppm for 72 hours' exposure, 0.5 - 2.7 ppm for 168 hours' exposure, and about 3 ppm for one month's exposure.(3) These laboratory tests also indicated that 3 ppm CrO_3 might be a maximum and that some of the CrO_2 and perhaps some of the CrO_3 formed would be reduced by the binder in the tape. Although it appears that a significant amount of the CrO_2 or CrO_2 breakdown products may be permanently trapped in the tape, the fact remains that some soluble chromium, particularly the chromate ion, will be released. The effect of long-term burial on tape decomposition and production of soluble chromium compounds is unknown and probably cannot be adequately simulated in the laboratory.

We must conclude that soluble chromium compounds will be produced by landfilling.

Water Pollution Potential

The concern in burying the waste tape at the Newport landfill is that soluble chromium compounds from the landfill site will either contaminate the area ground water supply or pollute the

ORIGINAL (Red)

Christina River. The United States Public Health Service has a mandatory limit of 0.05 mg/l (0.05 ppm) for hexavalent chromium in domestic water supplies. No limit has been set for trivalent chromium. Concentration of hexavalent chromium in ground water must then be limited to this amount if it is used as a source of drinking water. This limit is twenty times lower than the concentration of hexavalent chromium measured after prolonged exposure of tape to distilled water in the laboratory. In addition, the potential for pollution grows as the quantity of buried tape is increased. An estimated 51,000 pounds of CrO_2 in waste tape will be buried in the dump by the end of 1970. If we assume that one-third of the chromium from this tape becomes dissolved as hexavalent chromium, it would take 26 billion gallons of ground water to dilute it to the USPHS standard. Even if only .1% of this is taken as the probable amount of hexavalent chromium which will be released, this number if still a considerable 26 MM gallons. At present, there are no known wells for drinking water within the area of the plant; however, this may not always be the case.

Delaware water quality criteria presently only define in general the tolerable level of potentially toxic pollutants. The quality limits for toxic substances pertaining to the reach of the Christina River in the Newport vicinity is stated as "none in concentration harmful (synergistically or otherwise) to humans, fish, wildlife and aquatic life". The future intended uses of the river include recreation and the maintenance and propagation of fish, aquatic life and wildlife. Delaware, as well as most other states have applied the suggested levels of pollutants presented by McKee and Wolf.(4) This reference suggests maximum levels of 0.05 mg/l Cr for both trivalent or hexavalent forms.

The amount of chromium reaching the Christina River would be a function of the drainage from the dump. The net average flow of the Christina is about 200 cu ft/sec, and the minimum about 10% of that. This means that to restrict the concentration of chromium to 0.05 ppm, chromium leakage to the river would have to be restricted to about 0.22 lb/hr during minimum flow and about ten times that during average flow. As a method of comparison, if we assume that the leakage to the Christina equals the maximum 0.03 wt % decomposition of the anticipated 51,000 pounds of chromium dioxide in the dump, 3.3 lb/hr of hexavalent chromium would be released. Considering the small amount of chromium needed to exceed the criteria we must accept that river contamination through landfill drainage is possible.

Adequacy of Present Landfill

The amount of ground water or stream pollution which may result from burying the tape at Newport is a function of many variables. The effect of burial on tape decomposition is unknown. Acid soil (most probable) would speed the reduction of hexavalent chromium to the trivalent form, but also increase the solubility and mobility

ORIGINAL (Red)

of the hexavalent form. Organic materials in the soil would also tend to reduce the hexavalent chromium. Alkaline soil would tend to reduce the solubility and mobility of trivalent chromium compounds, but would tend to stabilize the hexavalent chromates. In the final analysis, we cannot count on soil chemistry to prevent the slow solution and migration of chromium compounds from the landfill area. The major factor in preventing ground water or stream pollution is the ability of the soil to retard the migration of the soluble compounds which may be produced.

Because large quantities of chromium tape have already been landfilled at the Newport site, and alternate disposal schemes are not immediately available, I have had tests made at the disposal site to determine the adequacy of the present method. Test borings were made to measure the permeability of the soil and piezometers were placed in a number of these borings so that ground water in the area of the disposal site could be monitored for chromium content. Exhibit I attached shows the exact location and elevation of each of the borings. Exhibit II is a graphical representation of the boring logs with the locations of the well points shown. The original boring logs are also attached. These logs show that the upper 2-13 feet is composed of silty clay with layers of sand beneath. This sand is wet and determines the water table level throughout the dump. Except for the extreme northeast corner of the landfill area, the upper silty clay layer is at least 8 feet deep. Shelby tube borings were taken throughout this layer for undistrubed samples to be used in permeability tests.

Exhibit III shows the results of permeability tests, sieve analyses, liquid limit and placticity index tests. The measured permeabilities of less than 10^{-6} cm/sec indicate that this layer is practically impervious. Liquid limit, placticity index and sieve analyses results confirm that the upper layer is a clayey silt which would be expected to have low permeabilities. Although the permeability of the upper layer of the dump is not as low as that of pure clay, its ability to retard migration of compounds dissolved from the tape should be good.

Five well points were placed in the bore holes toward which the drainage from the landfilled area would be expected to flow. Analyses of water samples from these wells gave no indication of chromium from Well BD-4 and less than 0.1 ppm total chromium for the remaining wells, BD-5 through BD-8. These results are at the limit of analytical ability to detect chromium and are not highly accurate because small water samples were supplied for analysis. The results are encouraging in that high concentrations of chromium were not detected. However, they are in the range of USPHS limits for chromium previously mentioned. The small amount of chromium detected may actually be the background amount in the waters of this area rather than an indication of small amounts of chromium being released from the landfill area.

Further analyses using larger samples of water are necessary. I have recommended that each of these wells be resampled and, in order to determine background quantities of chromium, that a distant well in the plant be sampled and samples be taken of the Christina River upstream and downstream of the landfill area. This program is underway.

In light of the evidence to date, I believe that closely supervised burial of waste "Crolyn" tape may be continued at this site. I recommend that burial trenches be no deeper than 6-7 feet. If a wet sandy layer is uncovered while digging, the pit must be refilled and not used for burial. The waste tape should be buried in large polyethylene bags as is presently done. Tape should be compacted as much as possible to conserve space. Borings were only taken in the immediate area of the present burial site and it is not known how extensive the area containing adequate depths of clayey soil is. In addition to close supervision of burial, I recommend that the wells be sampled quarterly to determine if there is any increase in chromium. This must be a continuing program since migration of contaminants from landfill is normally a very slow process and contamination might not be detected for years.

I believe that landfill of waste tape at the Newport dumps is an adequate solution for the short run. However, if large quantities of waste tape are to be produced year after year, a more suitable disposal method will have to be found. Very large accumulations of waste tape buried at this location, regardless of the precautions taken, constitute a very real environmental threat. In addition, the ultimate cost of landfill will be high as land which might be used for productive purposes is used up.

Alternative Disposal Methods

I have surveyed other methods which might be used for disposal of the tape if continued high scrap production is anticipated. My appraisal of various alternate methods is outlined in the following few paragraphs.

Burial at other sites in Newport is possible. Even though County landfill areas are thoroughly surveyed for potential of ground water pollution, I have ruled these out for "Crolyn" tape because of security reasons. Suitable areas for landfill are at a premium in Delaware and the situation is extremely critical in New Castle County. Contributions of large quantities of tape to these landfill areas would not be welcomed. If we were to dispose of continued large quantities of this tape by buiral on Du Pont sites, I would recommend that it be done in specifically excavated pits for this purpose which would be clay-lined. This would be expensive, particularly if purchase of new land would be required.

I have checked the possible use of land at Cherry Island presently belonging to the Pigments Department. This land is urgently needed by Pigments Department for both chemical dumping and solid waste dumping. In addition, they are already experiencing pollution problems from the waste disposal at the plant, and this area can be ruled out for disposal of "Crolyn". Generally, burial of "Crolyn" tape is unattractive from both the pollution and economic standpoint in the long run.

Incineration is attractive in that the residue ash would consist primarily of Cr_2O_3. This material might then be returned to chromic acid manufacturers for reprocessing. Incineration of Mylar® base tapes is not easy and considerable developmental effort would be required to design a workable system. Attention will have to be given to the control of emissions of chromium containing compounds to the atmosphere. Although neither incineration nor other methods of recovery of chromium from the tape will be inexpensive, such methods for the disposal of tape must be developed if long-term production of waste tape is anticipated. Consequently, I recommend that a Photo Products Department program be instituted to find an acceptable alternate means of disposal, stressing recovery or recycle of the chromium.

Contract disposal of the tape has not looked attractive, primarily because the disposal services would haul the wastes away only to be landfilled at another location. We would have little or no control of the way the landfill is carried out and we would have problems with security in being sure that the waste was disposed of. There is a new commercial waste disposal company, Rollins-Purle, Incorporated, (5) which is constructing waste dispersal facilities in Bridgeport, New Jersey. I believe they will run a reliable, competent operation and that we should have no security problems in dealing with these people.

James McLaughlin of Rollins-Purle said that they may be able to dispose of the tape, and will submit a proposal to me for the cost of haulage and disposal.

Drums of Settled CrO_2 Dispersion

In 1968, I recommended that Atlantic Industrial Tank Maintenance, Inc. be contracted to dispose of 60 water-filled drums containing settled CrO_2 dispersion.(6) Since that time, an additional 220 drums have been disposed of by this firm. About 150-200 more drums must be disposed of in 1970. Although I am somewhat concerned about Atlantic Tank Maintenance's burial procedures in light of the larger number of drums being buried than I anticipated, I believe we can continue to use their disposal service. I am engaged in a study of disposal services in this area. If I find their method of disposal is inadequate or that there are other services which will handle these wastes more adequately, I will let you know. I have contacted Rollins-Purle about these wastes and they feel that they can dispose of them. I do not have cost information at the present time, but will advise you as more information becomes available.

CrO_2 Powder

At present, about 10,000 pounds of off-specification CrO_2 powder is being stored at Newport. Unknown quantities of this material will be produced in the future. Some consideration had been given to adding sodium sulfite to drums of CrO_2 and landfilling them at the Newport Plant dump. As W.G. Bottjer pointed out in his letter of October 28, 1969, the proposed addition of sodium sulfite would not be large enough to complete the conversion of CrO_2 to $CrO(OH)$.(7) In any case, I strongly urge that drums of CrO_2 not be buried in the plant dump. As the drums corrode, large quantities of both sodium sulfite and CrO_2 would be made available for leaching in the ground water without benefit of the possible retarding of minimizing effect of a tape binder on leaching.

Since the CrO_2 contains chromium in concentrated form, I recommend that this material be returned to chromic acid manufacturers for recycle. If there is concern about security, I suggest that CrO_2 be recalcined to Cr_2O_3 before being sent off plant.

P. A. Palmer
2/10/70

C... ..AL
(Red)

REFERENCES

(1) (Tape Leaching) DRD-66-IV - Laboratory Support for Magnetic Tape Venture - Reactions of CrO_2 and Organic Compounds. (William J. Bottjer)

(2) Memorandum - September 28, 1967 - R.W. Hendricks to D.M. Hiller Chromate Generation from Scrap Tape.

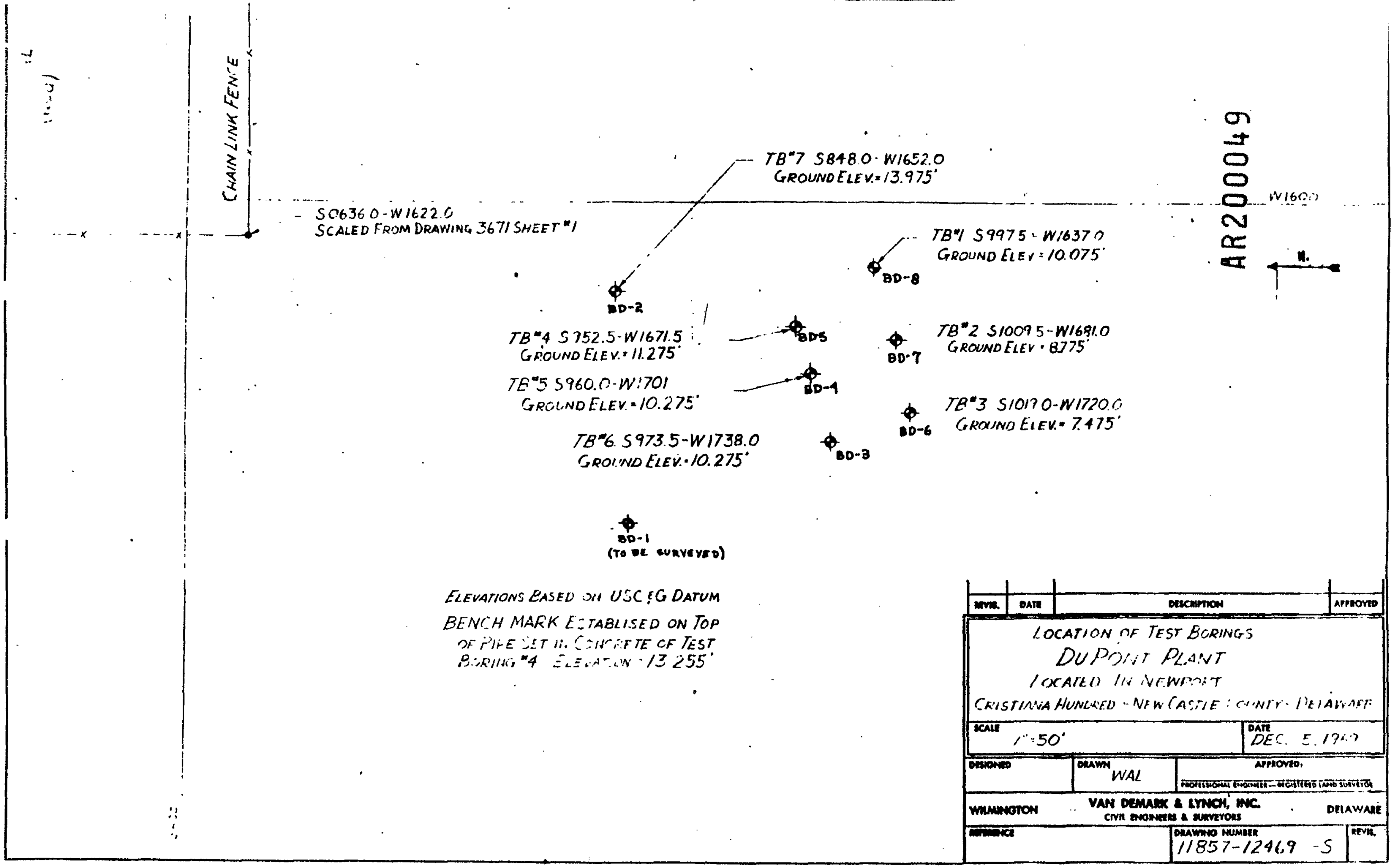
(3) Memorandum - October 7, 1969 - W.G. Bottjer to B. Meerkamper Examination of Possible Contamination of Water Supplies by Burial of "Crolyn" Tape.

(4) "Water Quality Criteria, 2nd Edition", McKee and Wolf - The Resources Agency of California Publication No. 3-A (1963).

(5) Rollins-Purle, Inc.
10 W. Baltimore Avenue
Lansdowne, Pennsylvania 19050
Phone - 215-622-5005
Mr. James McLaughlin,
Director of Marketing

(6) Letter - September 12, 1968 - P.A. Palmer to W.B. Jennings - Photo Products Department - Newport R&D - Waste Disposal Magnetic Tape Venture - Waste Tape Disposal.

(7) Memorandum - October 28, 1969 - W.G. Bottjer to R.F. Bree - CrO_2 Waste Disposal.


CHAIN LINK FENCE
S0636.0-W1622.0
SCALED FROM DRAWING 3671 SHEET #1
TB#7 S848.0-W1652.0
GROUND ELEV.=13.975'
TB#1 S997.5-W1637.0
GROUND ELEV=10.075'
W1600
N.
BD-2
BD-8
BD5
BD-7
BD-4
BD-6
BD-3
TB#4 S952.5-W1671.5
GROUND ELEV.=11.275'
TB#5 S960.0-W1701
GROUND ELEV.=10.275'
TB#2 S1009.5-W1681.0
GROUND ELEV=8.775'
TB#3 S1017.0-W1720.0
GROUND ELEV.=7.475'
TB#6 S973.5-W1738.0
GROUND ELEV.=10.275'
BD-1
(TO BE SURVEYED)
ELEVATIONS BASED ON USC&G DATUM
BENCH MARK ESTABLISED ON TOP OF PIPE SET IN CONCRETE OF TEST BORING #4 ELEVATION 13.255'
REVIS.
DATE
DESCRIPTION
APPROVED
LOCATION OF TEST BORINGS
DUPONT PLANT
LOCATED IN NEWPORT
CRISTIANA HUNDRED - NEW CASTLE COUNTY - DELAWARE
SCALE
1"=50'
DATE
DEC. 5, 19
DESIGNED
DRAWN
WAL
APPROVED:
PROFESSIONAL ENGINEER—REGISTERED LAND SURVEYOR
WILMINGTON
VAN DEMARK & LYNCH, INC.
CIVIL ENGINEERS & SURVEYORS
DELAWARE
REFERENCE
DRAWING NUMBER
11857-12469-S
REVIS.

AR200049

EXHIBIT II

G-46-A REV. 8-68

ENGINEERING DUPONT COMPUTATION SHEET

SHEET No. ______

TITLE OF PROJ. OR STUDY ______ PROJ. OR STUDY NO. ______

SUBJECT Newport Waste Tape Disposal Area WORKS ______

Boring Logs COMPUTER P.A. Palmer DATE ______ 19__

ORIGINAL

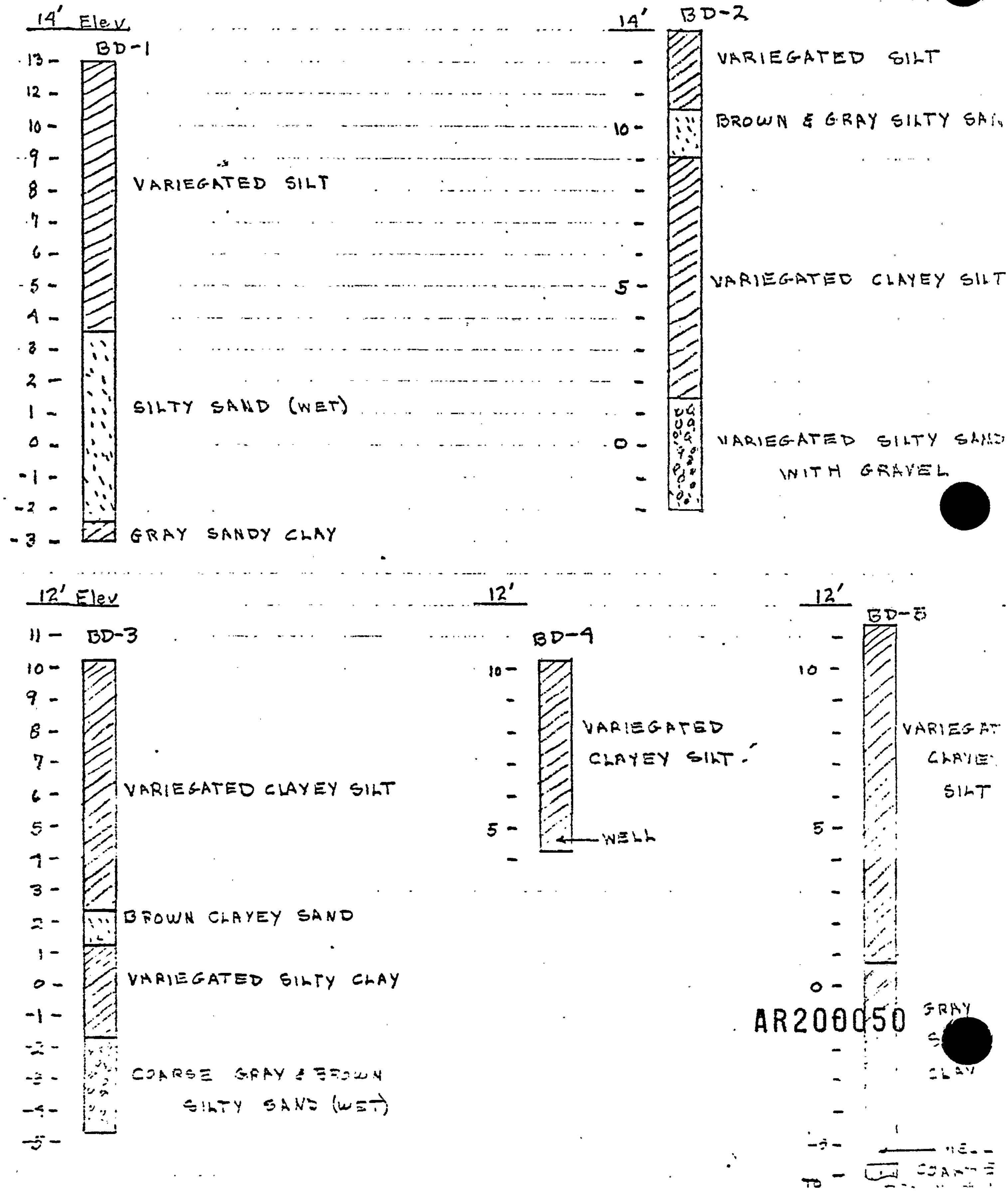


EXHIBIT II CON

G-46-A REV. 8-68

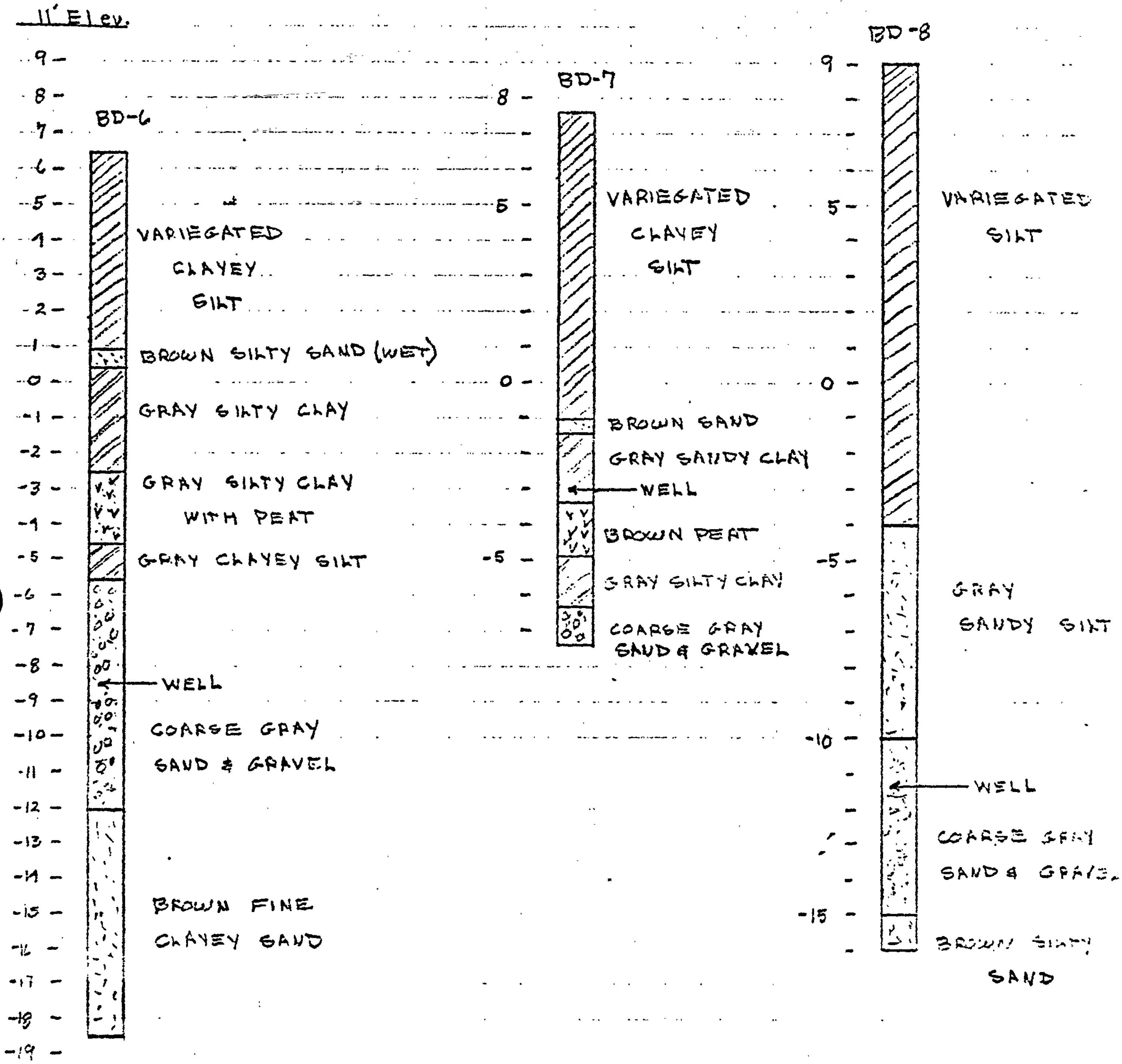
ENGINEERING DUPONT COMPUTATION SHEET

SHEET No. ______

TITLE OF PROJ. OR STUDY ______ PROJ. OR STUDY NO. ______

SUBJECT Newport Waste Tape Disposal Area WORKS ______

Boring Logs COMPUTER P. A. Palmer DATE ______ 19__



AR200051

USE STANDARDS FOR MINIMUM ESSENTIAL ...

EXHIBIT II CONT

WALTON CORPORATION
Drilling Contractor
NEWARK, DELAWARE 19711

BORING LOG

AME DuPont Company PROJECT NO.

Land Fill, Newport, Delaware SUPERVISOR R. Howard

ORING NO.	DRILLER	DATE
BD-1	J. Holtzman	6-13-69
ATHER Fair	SURFACE ELEVATION	DATUM

Sample No.	Sample Depth - Feet From	Sample Depth - Feet To	Depth Strata Feet From	Depth Strata Feet To	Driller's Description of Materials	*Blows A		
1	0	1.5			Variegated Silt	3	4	4
2	2.5	4.0			" "	4	8	11
3	4.0	6.0			" "	Shelby		
4	6.0	7.5		8.5	" "	6	7	6
5	8.5	10.0	8.5		Brown Silty Sand (Wet)	5	7	8
6	11.0	12.5			" " " "	5	8	10
				14.8	" " " "			
7	13.5	15.0	14.8	15.0	Gray Sandy Clay	5	5	11

* BLOWS ON CASING B
0- 1
1- 2
2- 3
3- 4
4- 5
5- 6
6- 7
7- 8
8- 9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
24-25
25-26
26-27
27-28
28-29
29-30
30-31
31-32
32-33
33-34
34-35
35-36
36-37
37-38
38-39
39-40
40-41
41-42
42-43
43-44
44-45
45-46
46-47
47-48
48-49
49-50
50-51
51-52
52-53
53-54
54-55
55-56
56-57
57-58
58-59
59-60
60-61

*A Number of blows of 140 lb. hammer dropped 30 in. required to drive 2 in. split-spoon sampler for each of three 6 in. increments.

* B Number of blows of 300 lb. hammer dropped 18 in. required to drive .... in. casing 12 inches.

REMARKS: AR200052

GROUND WATER

6-13-69	1:10	7.0

EXHIBIT II CONT'D

ORIGINAL (Red)

WALTON CORPORATION
Drilling Contractor
NEWARK, DELAWARE 19711

BORING LOG

DuPont Company .... PROJECT NO. ....

Land Fill, Newport, Delaware .... SUPERVISOR R. Howard

NG NO. BD-2 | DRILLER J. Holtzman | DATE 6-16-69

THER Fair | SURFACE ELEVATION | DATUM

ple o.	Sample Depth - Feet From	Sample Depth - Feet To	Depth Strata Feet From	Depth Strata Feet To	Driller's Description of Materials	*Blows A		
	0	1.5	0	2.5	Variegated Silt	4	3	3
2	2.5	4.0	2.5	4.0	Brown & Gray Silty Sand (Wet)	10	7	8
3	4.0	6.0	4.0		Variegated Clayey Silt	Shelby		
4	6.0	7.5		8.5	" " "	4	4	7
5	8.5	10.0		11.5	" " "	1	2	3
6	11.0	12.5	11.5		Variegated Silty Sand w/Gravel	6	15	14
7	13.5	15.0		15.0	" " " " "	7	4	6

* BLOWS ON CASING B
0- 1
1- 2
2- 3
3- 4
4- 5
5- 6
6- 7
7- 8
8- 9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
24-25
25-26
26-27
27-28
28-29
29-30
30-31
31-32
32-33
33-34
34-35
35-36
36-37
37-38
38-39
39-40
40-41
41-42
42-43
43-44
44-45
45-46
46-47
47-48
48-49
49-50
50-51
51-52
52-53
53-54
54-55
55-56
56-57
57-58
58-59
59-60
60-61

A Number of blows of 140 lb. hammer dropped 30 in. required to drive 2 in. split-spoon sampler for each of three 6 in. increments.

B Number of blows of 300 lb. hammer dropped 18 in. required to drive .... in. casing 12 inches.

AR200053

REMARKS: ....

GROUND WATER

6-13-69	1:05 P.M.	4.0
6-16-69	At Completion	6.0

EXHIBIT II CONT'D

WALTON CORPORATION
Drilling Contractor
NEWARK, DELAWARE 19711

BORING LOG

NAME DuPont Company PROJECT NO.

Land Fill, Newport, Delaware SUPERVISOR R. Howard

BORING NO.	DRILLER	DATE
BD-3	J. Holtzman	6-13-69
WEATHER	SURFACE ELEVATION	DATUM
Fair		

Sample No.	Sample Depth - Feet From	Sample Depth - Feet To	Depth Strata Feet From	Depth Strata Feet To	Driller's Description of Materials	*Blows A		
1	0	1.5	0		Variegated Clayey Silt	2	4	4
2	4.0	5.5		8.0	" " "	6	7	9
3	7.0	9.0	8.0	9.0	Brown Clayey Sand	Shelby		
4	9.0	10.5		12.0	Variegated Silty Clay	2	3	4
5	13.5	15.0	12.0	15.0	Coarse Gray & Brown Silty Sand (Wet)	2	4	8

* BLOWS ON CASING B	
0- 1	
1- 2	
2- 3	80 (Ref)
3- 4	
4- 5	
5- 6	
6- 7	
7- 8	
8- 9	
9-10	
10-11	
11-12	
12-13	
13-14	
14-15	
15-16	
16-17	
17-18	
18-19	
19-20	
20-21	
21-22	
22-23	
23-24	
24-25	
25-26	
26-27	
27-28	
28-29	
29-30	
30-31	
31-32	
32-33	
33-34	
34-35	
35-36	
36-37	
37-38	
38-39	
39-40	
40-41	
41-42	
42-43	
43-44	
44-45	
45-46	
46-47	
47-48	
48-49	
49-50	
50-51	
51-52	
52-53	
53-54	
54-55	
55-56	
56-57	
57-58	
58-59	
59-60	
60-61	

*A Number of blows of 140 lb. hammer dropped 30 in. required to drive 2 in. split-spoon sampler for each of three 6 in. increments.

** B Number of blows of 300 lb. hammer dropped 18 in. required to drive .... in. casing 12 inches.

AR200054

REMARKS:

GROUND WATER

6-13-69	1 P.M.	2.5

EXHIBIT II CONT

WALTON CORPORATION
Drilling Contractor
NEWARK, DELAWARE 19711

BORING LOG

NAME DuPont Company .... PROJECT NO. ....

Land Fill, Newport, Delaware .... SUPERVISOR R. Howard ....

BORING NO. BD-4 | DRILLER J. Holtzman | DATE 6-13-69

WEATHER Fair | SURFACE ELEVATION | DATUM

Sample No.	Sample Depth - Feet From	Sample Depth - Feet To	Depth Strata Feet From	Depth Strata Feet To	Driller's Description of Materials	*Blows A		
1	0	1.5	0		Variegated Clayey Silt	2	2	3
2	2.5	4.0			" " "	Shelby		
	4.5	6.0		6.0	" " "	10	11	14

* BLOWS ON CASING B ORIGINAL (Red)
1- 2
2- 3
3- 4
4- 5
5- 6
6- 7
7- 8
8- 9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
24-25
25-26
26-27
27-28
28-29
29-30
30-31
31-32
32-33
33-34
34-35
35-36
36-37
37-38
38-39
39-40
40-41
41-42
42-43
43-44
44-45
45-46
46-47
47-48
48-49
49-50
50-51
51-52
52-53
53-54
54-55
55-56
56-57
57-58
58-59
59-60
60-61

*A Number of blows of 140 lb. hammer dropped 30 in. required to drive 2 in. split-spoon sampler for each of three 6 in. increments.

* B Number of blows of 300 lb. hammer dropped 18 in. required to drive .... in. casing 12 inches.

REMARKS: 5.0' 2" Gal. Pipe
1 C/M 2" x 36" Well Point
Top of Screen 3.0' Bottom 5.5'

AR200055

GROUND WATER

6-13-69	1 P.M.	6.0
		Dry

EXHIBIT II CONT'D

ORIGINAL (Red)

WALTON CORPORATION
Drilling Contractor
NEWARK, DELAWARE 19711

BORING LOG

NAME DuPont Company .... PROJECT NO. ....

Land Fill, Newport, Delaware .... SUPERVISOR R. Howard ....

BORING NO.	DRILLER	DATE
BD-5	J. Holtzman	6-12-69
WEATHER Fair	SURFACE ELEVATION	DATUM

Sample No.	Sample Depth - Feet From	To	Depth Strata Feet From	To	Driller's Description of Materials	*Blows A		
1	0	1.5	0		Variegated Clayey Silt	3	3	4
2	4.0	6.0			" " "	Shelby		
3	6.0	7.5			" " "	5	7	10
4	8.5	10.0		10.5	" " "	6	7	10
5	11.0	12.5	10.5		Gray Silty Clay	3	4	4
6	13.5	15.0		17.5	" " "	1	2	3
7	18.5	20.0	17.5	24.5	Coarse Brown Sand & Gravel	9	16	18
8	23.5	25.0	24.5	25.0	Brown Fine Silty Sand	6	6	4

* BLOWS ON CASING B
0- 1
1- 2
2- 3
3- 4
4- 5
5- 6
6- 7
7- 8
8- 9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
24-25
25-26
26-27
27-28
28-29
29-30
30-31
31-32
32-33
33-34
34-35
35-36
36-37
37-38
38-39
39-40
40-41
41-42
42-43
43-44
44-45
45-46
46-47
47-48
48-49
49-50
50-51
51-52
52-53
53-54
54-55
55-56
56-57
57-58
58-59
59-60
60-61

*A Number of blows of 140 lb. hammer dropped 30 in. required to drive 2 in. split-spoon sampler for each of three 6 in. increments.

* B Number of blows of 300 lb. hammer dropped 18 in. required to drive .... in. casing 12 inches.

REMARKS: 19.5' 2" Gal. Pipe ....

AR200056

.... 1 - G/M Well Point (Button Type) 2"x48" ....

.... Top of Screen 17.5 ....

GROUND WATER

6-13-69	1:05P.M.	4.0

EXHIBIT II CONT'

WALTON CORPORATION

Drilling Contractor

NEWARK, DELAWARE 19711

BORING LOG

AME DuPont Company PROJECT NO.

Lnad Fill, Newport, Delaware SUPERVISOR R. Howard

BORING NO.	DRILLER	DATE
BD-6	J. Holtzman	6-12-69
WEATHER	SURFACE ELEVATION	DATUM
Fair		

Sample No.	Sample Depth - Feet From	Sample Depth - Feet To	Depth Strata Feet From	Depth Strata Feet To	Driller's Description of Materials	*Blows A		
1	0	1.5	0		Variegated Clayey Silt	3	4	7
2	2.5	4.0		4.0	" " "	7	10	15
3	4.0	5.5		5.5	" " "	Shelby		
			5.5	6.0	Brown Silty Sand (Wet)			
4	5.5	7.0		9.0	Gray Silty Clay	5	4	4
5	8.5	10.0	9.0	11.0	Gray Clayey Silt w/Peat	1	2	3
6	11.0	12.5	10.0	12.0	Gray Clayey Silt	1	5	7
			12.0		Coarse Gray Sand & Gravel			
	13.5	15.0		18.5	" " " " "	6	7	8
8	18.5	20.0	18.5		Brown Fine Clayey Sand	6	9	10
9	23.5	25.0		25.0	" " " "	10	11	10

* BLOWS ON CASING B
0-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
24-25
25-26
26-27
27-28
28-29
29-30
30-31
31-32
32-33
33-34
34-35
35-36
36-37
37-38
38-39
39-40
40-41
41-42
42-43
43-44
44-45
45-46
46-47
47-48
48-49
49-50
50-51
51-52
52-53
53-54
54-55
55-56
56-57
57-58
58-59
59-60
60-61

ORIGINAL (Red)

*A Number of blows of 140 lb. hammer dropped 30 in. required to drive 2 in. split-spoon sampler for each of three 6 in. increments.

* B Number of blows of 300 lb. hammer dropped 18 in. required to drive .... in. casing 12 inches.

ARKS: 21.0' Gal. Pipe 2"

1 C/M Well Point (Button Type) 2"x48"

Top of Screen 19.0

AR200057

GROUND WATER		
6-13-69	1 P.M.	1.2

EXHIBIT II CONT'D

WALTON CORPORATION

Drilling Contractor

NEWARK, DELAWARE 19711

BORING LOG

AME DuPont Company .... PROJECT NO. ....

Land Fill, Newport, Delaware .... SUPERVISOR R. Howard

ORING NO.	DRILLER	DATE
BD-7	J. Holtzman	6-12-69
/EATHER	SURFACE ELEVATION	DATUM
Fair		

Sample No.	Sample Depth - Feet From	Sample Depth - Feet To	Depth Strata Feet From	Depth Strata Feet To	Driller's Description of Materials	*Blows A		
1	0	1.5	0		Variegated Clayey Silt	4	4	3
S-2	2.0	4.0			" " "	Shelby		
3	4.0	5.5			" " "	5	11	11
S-4	7.0	8.5		8.5	" " "	Shelby		
5	8.5	10.0	8.5	9.0	Med. Brown Sand (Wet W.L. 5.4)	3	3	5
			9.0	11.0	Gray Sandy Clay			
6	11.0	12.5	11.0	12.5	Brown Peat	3	4	5
			12.5	14.0	Gray Silty Clay			
7	13.5	15.0	14.0	15.0	Coarse Gray Sand & Gravel	6	6	6

* BLOWS ON CASING B
0- 1 (neg)
1- 2
2- 3
3- 4
4- 5
5- 6
6- 7
7- 8
8- 9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
24-25
25-26
26-27
27-28
28-29
29-30
30-31
31-32
32-33
33-34
34-35
35-36
36-37
37-38
38-39
39-40
40-41
41-42
42-43
43-44
44-45
45-46
46-47
47-48
48-49
49-50
50-51
51-52
52-53
53-54
54-55
55-56
56-57
57-58
58-59
59-60
60-61

*A Number of blows of 140 lb. hammer dropped 30 in. required to drive 2 in. split-spoon sampler for each of three 6 in. increments.

* B Number of blows of 300 lb. hammer dropped 18 in. required to drive .... in. casing 12 inches.

REMARKS: 13.0' - 2" Gal. Pipe AR200058

1 C/M Well Point 2"x48"

Top of Screen 11.5

GROUND WATER

6-13-69	1 P.M.	3.0

…BIT II CONT'D

WALTON CORPORATION
Drilling Contractor
NEWARK, DELAWARE 19711

BORING LOG

NAME DuPont Company .... PROJECT NO. ....

Land Fill, ... Newport, Delaware .... SUPERVISOR R. Howard ....

BORING NO.	DRILLER	DATE
BD-8	J. Holtzman	6-16-69
WEATHER	**SURFACE ELEVATION**	**DATUM**
Fair		

Sample No.	Sample Depth - Feet From	Sample Depth - Feet To	Depth Strata Feet From	Depth Strata Feet To	Driller's Description of Materials	*Blows A		
1	0	1.5	0		Variegated Silt	3	4	3
2	2.5	4.0		3.5	" "	2	2	2
3	4.0	6.0	3.5	6.0	Variegated Silty Clay	Shelby		
4	6.0	7.5	6.0		Variegated Silt	5	8	9
5	9.5	11.0		13.0	Variegated Silt	4	7	9
			13.0	14.0	Gray Sandy Silt (Wet)			
			14.0	14.2	Gray Silty Sand			
[illegible]	13.5	15.0	14.2	19.0	Gray Sandy Silt	2	2	2
[illegible]	18.5	20.0		24.0	Coarse Gray Sand & Gravel	4	2	7
8	23.5	25.0	24.0	25.0	Brown Silty Sand	6	9	8

*A Number of blows of 140 lb. hammer dropped 30 in. required to drive 2 in. split-spoon sampler for each of three 6 in. increments.

*B Number of blows of 300 lb. hammer dropped 18 in. required to drive .... in. casing 12 inches.

REMARKS: 13.0' - 2" Gal. Pipe

AR200059

1 C/M #327 Well Point (Button Type) 2"x48"

Top of Screen 11.5'

GROUND WATER		
6-13-69	1 P.M.	3.5

* BLOWS ON CASING B
ORIGINAL (Red)
2- 3
3- 4
4- 5
5- 6
6- 7
7- 8
8- 9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
24-25
25-26
26-27
27-28
28-29
29-30
30-31
31-32
32-33
33-34
34-35
35-36
36-37
37-38
38-39
39-40
40-41
41-42
42-43
43-44
44-45
45-46
46-47
47-48
48-49
49-50
50-51
51-52
52-53
53-54
54-55
55-56
56-57
57-58
58-59
59-60
60-61

EXHIBIT III

ORIGINAL (Red)

GEOTEC ASSOCIATES

302 Beverly Road
Newark, Delaware

NEWPORT, DELAWARE

SAMPLE	PERMEABILITY cm/sec x 10^{-7}	NATURAL MOISTURE	LL	PL	PI	%Passing #20
BD 2, 4-6'	2.9	22.5	48.4	28.7	20	
3, 7-9'	72.1	15.6	NP	NP		18
5, 4-6'	16.4	24.5	28.1	23.7	4	
6, 4-5.5'	5.5	18.7	33.4	20.4	13	
7, 2-4	13.5	21.5	29.5	23.0	6	88
7, 7-8.5	6.1	21.9	27.8	23.0	5	32
8, 4-6	19.2	22.0	27.9	23.6	4	89

R. Nicholls 6-18-69

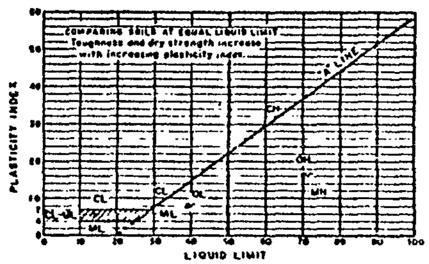
AR200060

UNIFIED SOIL CLASSIFICATION
INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3 inches and basing fractions on estimated weights)				GROUP SYMBOLS [a]	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size. [b] (The No. 200 sieve size is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size. (For visual classifications, the ¼" size may be used as equivalent to the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel-sand mixtures, little or no fines.	Give typical name; indicate approximate percentages of sand and gravel, max. size, angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information, and symbol in parentheses.	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics.	Atterberg limits below "A" line, or PI less than 4 — Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols.
			Plastic fines (for identification procedures see CL below).	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.		Atterberg limits above "A" line with PI greater than 7
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.	SW	Well graded sands, gravelly sands, little or no fines.		$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.	EXAMPLE:- Silty sand, gravelly; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains, coarse to fine; about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand, (SM)	Not meeting all gradation requirements for SW
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).	SM	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or PI less than 4 — Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
			Plastic fines (for identification procedures see CL below).	SC	Clayey sands, poorly graded sand-clay mixtures.		Atterberg limits above "A" line with PI greater than 7

Laboratory classification criteria for coarse grained soils: Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows:- Less than 5% GW, GP, SW, SP; More than 12% GM, GC, SM, SC; 5% to 12% Borderline cases requiring use of dual symbols.

FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve size. (The No. 200 sieve size is about the smallest particle visible to the naked eye)	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE: DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	GROUP SYMBOLS	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS
SILTS AND CLAYS Liquid limit less than 50	None to slight	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; color in wet condition, odor if any, local or geologic name, and other pertinent descriptive information; and symbol in parentheses.
	Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
	Slight to medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity.	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.
SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
	High to very high	None	High	CH	Inorganic clays of high plasticity, fat clays.	EXAMPLE:- Clayey silt, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML)
	Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity.	
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt	Peat and other highly organic soils	



PLASTICITY CHART

FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

a Boundary classifications. Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.

b All sieve sizes on this chart are U.S. standard

FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

DILATANCY (Reaction to shaking)

After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky.

Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens, and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

DRY STRENGTH (Crushing characteristics)

After removing particles larger than No. 40 sieve size, mold a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun, or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

TOUGHNESS (Consistency near plastic limit)

After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size, is molded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eighth inch in diameter. The thread is then folded and rerolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

Original (Red)

12

COEFFICIENT OF PERMEABILITY CHART BY A. CASAGRANDE

"k" in cm. per sec. x 1.97 = ft. per min. or x 14.75 = gal. per sq. ft. per min. (log scale)

10^{2} 10^{1} 1.0 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5} 10^{-6} 10^{-7} 10^{-8} 10^{-9}

RAINAGE ROPERTIES	Good Drainage; Poor Drainage; Practically Impervious
LICATION RTH DAMS DIKES	Pervious Sections of Earth Dams and Dikes; Impervious Sections of Earth Dams and Dikes
ES OF SOIL	Clean Gravel; Clean Sand / Clean Sand and Gravel Mixtures; Very Fine Sands; Organic and Inorganic Silts; Mixtures of Sand, Silt, and Clay; Glacial Till; Stratified Clay Deposits; etc.; "Impervious" Soils e.g. Homogeneous Clays Below Zone of Weathering
	"Impervious Soils" which are modified by the effects of vegetation and weathering
DIRECT ERMINATION COEFFICIENT PERMEABILITY	DIRECT TESTING OF SOIL IN ITS ORIGINAL POSITION (e.g. Well Points) Reliable if properly conducted. Considerable Experience Required.
	CONSTANT HEAD PERMEAMETER Little Experience Required
	TURBULENT FLOW FOR HYDRAULIC GRADIENTS LARGER THAN TEN.
	FALLING HEAD PERMEAMETER: Reliable Little Experience Required; Unreliable Much Experience Necessary for Correct Interpretation; Fairly Reliable Considerable Experience Necessary
INDIRECT ERMINATION COEFFICIENT PERMEABILITY	COMPUTATIONS From Grain Size Distribution. (e.g. Hazen's Formula). Applicable Only to Clean Cohesionless Sands and Gravels
	HORIZONTAL CAPILLARITY TEST Very Little Experience Necessary. Especially Useful for Rapid Testing of a Large Number of Samples in the Field without Laboratory Facilities.
	COMPUTATIONS From Consolidation Tests. Expensive Laboratory Equipment and Considerable Experience Required.

10^{2} 10^{1} 1.0 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5} 10^{-6} 10^{-7} 10^{-8} 10^{-9}

AR200062

ORIGINAL (Red)

GEOTEC ASSOCIATES

302 Beverly Road
Newark, Delaware

ORIGINAL (Red)

NEWPORT

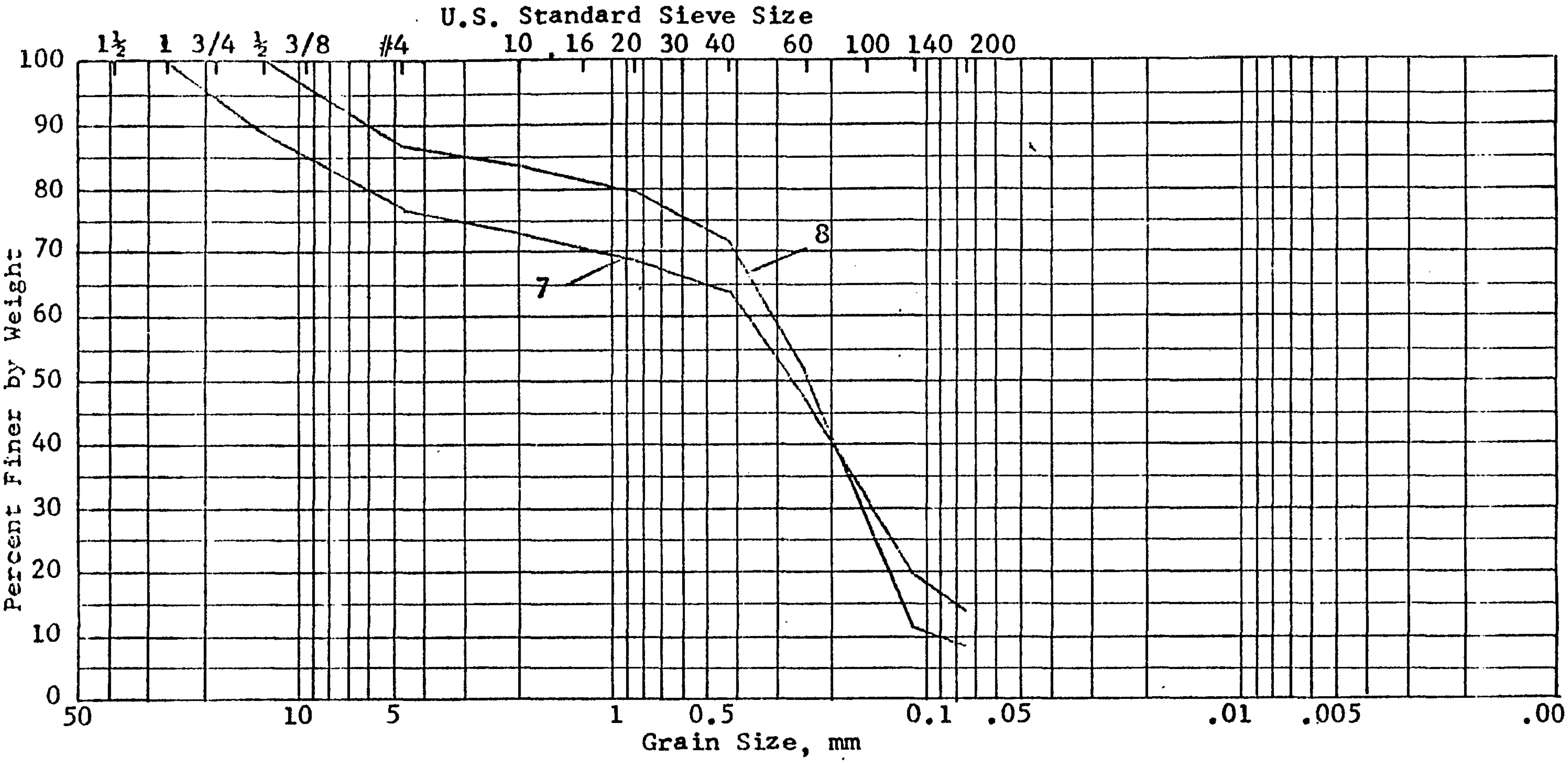
Boring	Sample	Natural Moisture	LL	PL	PI	% Passing #200
BD 5	1	38.1	29.7	25.3	4	79
	3	23.6	28.1	21.5	7	89
	4	22.7	25.3	20.1	5	87
	5	31.4	29.4	23.2	6	99
	6	32.5	33.6	24.0	10	96
	7	30.8	NP	NP		see attached sieve analysis
	8	23.5	NP	NP		sieve
BD6	1	21.0	30.4	20.8	10	88
	2	14.4	28.5	19.9	9	91
	4	20.3	20.8	18.0	3	65
	5	118	55.6	43.0	13	100
	6	52.1	42.1	32.8	9	96
	7	15.5	NP	NP		sieve
	8	16.7	NP	NP		sieve
	9	13.5	NP	NP		sieve

AR200063

6-25-69 rln

EOTEC ASSOCIATES

302 Beverly Road
Newark, Delaware



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

Location	Sample	Depth	Nat W %	LL	PL	PI
Newport BD 5	7		30.8	NP	NP	
	8		23.5	NP	NP	

Technician rln

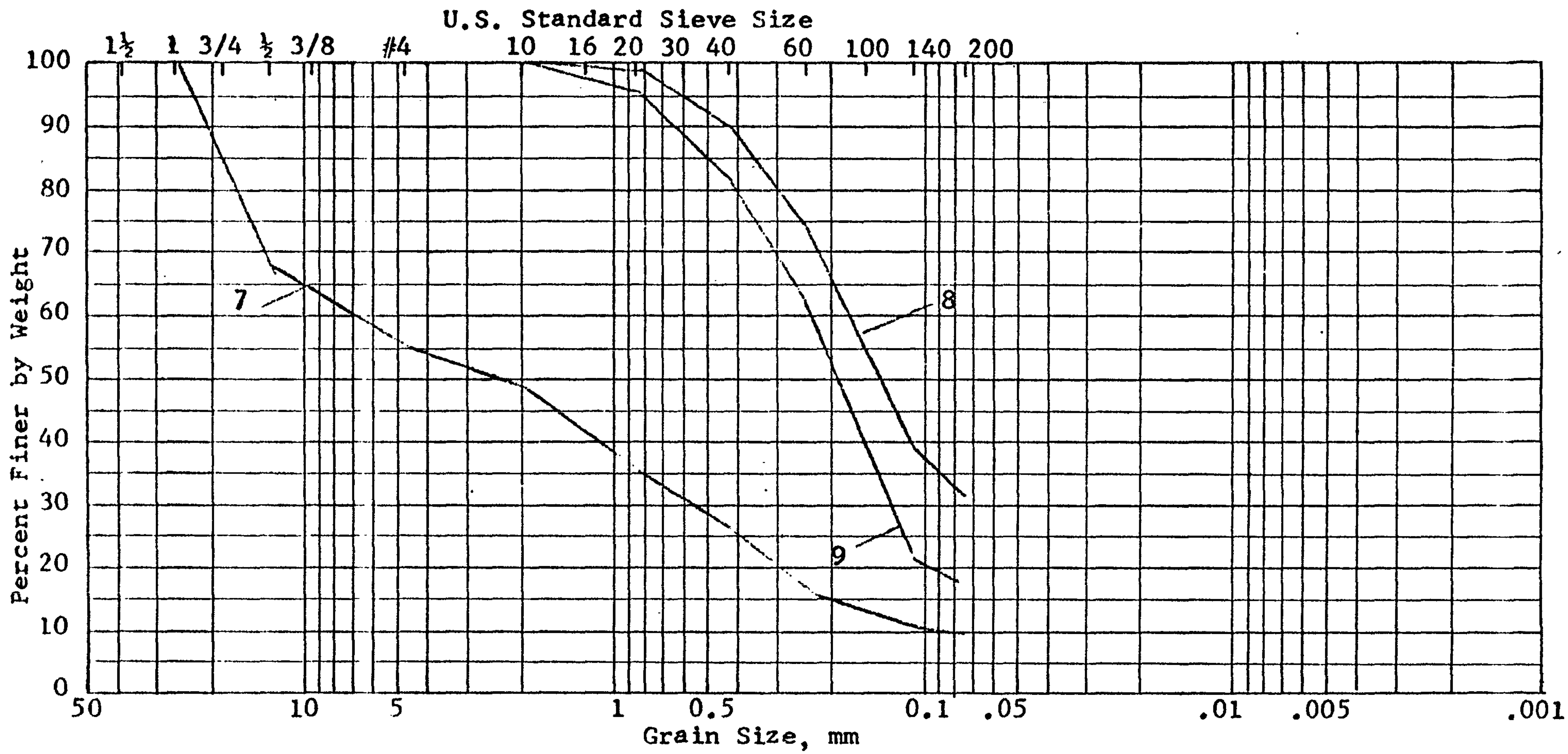
Date 6--25-69

SOIL CLASSIFICATION TESTS

AR200064

GEOTEC ASSOCIA[illegible]

3[illegible] Beverly Road
Newark, Delaware



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

Location	Sample	Depth	Nat W %	LL	PL	PI
Newport BD 6	7		15.5	NP	NP	
	8		16.7	NP	NP	
	9		13.5	NP	NP	

Technician rln

Date 6-25-69

SOIL CLASSIFICATION TESTS

AR200065

9-30-81

Mike

ORIGINAL (Red)

Sand-Cr_2O_3 Disposal
History

Limited details to date obtained from M. Straffer

- Some buried under #95 as extra fill (Believed) (Before 76)
- Some buried in an old Edgmoor landfill (Before 76) Believed
- 1976-1979 Rollins-Bridgeport N.J. Landfill
- 1979-1981 Stored on George Huber's site near Edgmoor
- Summer 81 - Some stored on George Huber site
  - 95% sent to BFI - Landfill - Kelly Rd. - Baltimore Md.

Pete

AR200066

FI-15 REV. 8-63

DU PONT
ESTABLISHED 1802
E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED
WILMINGTON, DELAWARE 19898

PHOTO PRODUCTS DEPARTMENT

ORIGINAL (Red)

December 10, 1969

TO: P. A. PALMER, L-13 WIO

FROM: W. B. JENNINGS WBJ

C O N F I D E N T I A L

SCRAP TAPE QUANTITIES

The following quantities of magnetic tape, expressed in terms of CrO_2 contained, have been buried at the Newport Plant Dump.

YEAR	M LBS. EQUIVALENT CR O_2
1967	2.5
1968	12.5
1969	26.0
TOTAL	41.0
Estimate 1970	10.0

WBJ/jhb

cc: R. M. Haire

AR200067

Photo Products Department
Experimental Station

cc: ~~R. Waller-Engg., L1015~~ ORIGINAL (Red)
W. B. Jennings-Newport
B. Meerkamper-E356
J. E. Dickens-E356
File A-4.2

September 28, 1967

MEMORANDUM

TO: D. M. HILLER

FROM: R. W. HENDRICKS RW Hendricks

CHROMATE GENERATION FROM SCRAP TAPE
Reference: Your Speedimemo of September 14, 1967

You requested information on the probability that scrap "Crolyn"TM magnetic tape would generate chromates when weathered, e.g., on the Newport plant dump and, hence, constitute a pollution problem.

We have information on a tape sample, H-13D (an early Huntley J65 formulation tape), which has been soaked in water for two years, which indicates the pollution hazard from scrap tape is minimal, if indeed there is any hazard. We do not feel this problem need be a cause for concern.

The work which follows is described on pages 223 and 227 of my notebook 65-II. On August 30, 1965, a 25 square inch sample of tape H-13D (containing approximately 214 mg. CrO_2) was put in a 4-ounce bottle of distilled water (about 115 ml.). A second bottle was made up with 200 mg. of CrO_2 D8-157 in 4 ounces of water. After 24 hours, no color was visible in the tape bottle, while the bottle containing oxide had reached a chromate concentration of approximately 1 mg./l. (from visual comparison with standard solutions). After two weeks (September 14, 1965), there was still no visible color in the tape bottle, and a test by W. G. Bottjer for chromate was negative. (From other work, 65-II, page 245, the oxide bottle would have been at a chromate level of approximately 50-100 mg./liter at this point. The two bottles were next placed in a 65°C. oven for twenty hours, after which the water in the tape bottle appeared "very slightly yellow," and the water in the oxide bottle had increased to a color corresponding to approximately 500 mg. CrO_4 per liter.

AR200068

ORIGINAL
(Red)

(Unfortunately, the contents were not analyzed more accurately at that time.) The bottles were then left to stand in John Dickens' office until now, and both appear to be unchanged after two years. The bottle containing tape still appears very slightly colored, and by comparison with standard solutions, the water contains approximately 5 mg. CrO_4 per liter. The bottle containing oxide still has about 500 mg. per liter, again by comparison with standards.

Despite the very slight water coloration which appears when tape is exposed to water even at 65°C., magnetic degradation is severe. Work by H. G. Ingersoll in later 1965 (my notebook 65-III, October 5, 1965) showed that a typical J365 tape lost 13% magnetically in 24 hours in water, versus 7% in air at 65°C./ 50% RH. The inference is that the oxide (or the chromic acid resulting from hydrolysis) reacts almost entirely with the binder, even when tape is soaked in water. Significantly, we have never found free chromic acid in oxide which has been exposed to a reducing agent, or from degraded tape samples. (W. G. Bottjer made careful x-ray studies in late 1965. The only degradation product found was γ-CrOOH.)

From this, we conclude that tape stored outdoors, or in contact with a large excess of water at room temperature, would generate essentially no extractable chromates. Tape generates chromates at least one hundred times less rapidly than oxide at 65°C. In my experiment, all of the 5 mg. per liter apparently originated during the 65° cycle, and virtually none at room temperature in two years. (No more than about 0.1% of the available chromium.)

If this does not suffice for your purposes, I suggest that larger quantities of tape be soaked in a large excess of water at room temperature, and the chromate concentration of the water be monitored by looking for color buildup. Standard colorimetric comparison methods can be used to establish low chromate levels quite accurately. This approach would, of course, actually represent an accelerated test, since tape would actually not be constantly soaked in liquid water on the Newport dump. This might, however, suffice to establish an upper limit of extractables more accurately than my data permit.

Call me if further clarification is needed.

RWH/dlc
9/28/67

ORIGINAL
(Red)

E. I. DU PONT DE NEMOURS & COMPANY

PIGMENTS DEPARTMENT

CC: E. L. Rodowskas
R. M. Salemi
E. H. Kolb
W. A. Roberson

Newport, Delaware
May 31, 1968

M E M O R A N D U M

TO: W. B. JENNINGS (2)

FROM: W. E. STUEFER

Tape contaminated with chromium dioxide, as you have frequently indicated, is a toxicity problem if burned. It is also a handling problem due to bulk and lightness. In accord with the need to keep separate from flammables and to minimize the burying problem, it is requested that all tape of this nature be kept separate from other area scrap and that it be bagged or secured in some other manner. It is also requested that means of further compacting it in the future be investigated.

WES/fc

AR200070

PHOTO PRODUCTS DEPARTMENT
Newport Plant

ORIGINAL (Red)

CC: R. M. Salemi
E. H. Kolb
W. B. Jennings III
M. Chiaverini
P. S. duPont IV
L. S. Smith

May 31, 1968

TO: W. E. STUEFER

FROM: J. R. HOGAN

Dump Materials -- Forecast

Ref: Letter to EHK from JRH -- 5/14/68

The following is additional information that you requested:

A. Dempster Dumpster Loads -- Dispersion/Coater Materials

Material Volumes	Present	Forecast -- Date 3Q68	4Q68
1. Scrap Magnetic Tape, $ft.^3$	1650	3500	7000
2. Compar Tubing Containing Dried Dispersion, $ft.^3$	25	25	25
3. Glass Jars and Tubing, $ft.^3$	2	3	5
4. Tin Cans, $ft.^3$	10	15	25
5. Small Amounts of Dispersion, $ft.^3$	1	1	2
6. Spent Filterite and Rigimesh filters, $ft.^3$	9	12	30
7. Lever Paks, $ft.^3$	80	80	120
TOTAL VOLUME, $Ft.^3$	1777	3636	7207
Number of Dempster Dumpster Loads, Per Month	11	22	44

AR200071

5/31/68

PHOTO PRODUCTS DEPARTMENT
Newport Plant

File

CC: E. L. Rodowskas
R. M. Salemi
E. H. Kolb
L. S. Smith
M. Chiaverini
Dr. Waller

ORIGINAL
(Red)

June 28, 1968

TO: W. E. STUEFER

FROM: W. B. JENNINGS

DISPOSAL OF SCRAP MAGNETIC TAPE
(Ref. your letter of 5/31/68 to W. B. Jennings)
(Ref. your letter of 6/11/68 to L. S. Smith)

Your letter of 5/31/68 requests more complete segregation of chromium containing waste from the Magnetic Tape area to permit proper disposal at the plant dump. While such segregation has been our previous practice, we have re-emphasized this fact to all personnel and we will follow-up to insure compliance. Our practice is summarized in the attached letter from M. Chiaverini.

We have investigated the possible use of a baler to reduce the bulk volume of scrap tape. High spot cost is $5-6000 without building.

Your letter of 6/11/68 requests that we consider off-plant disposal locations for chromium containing waste. We have requested the assistance of Dr. Robert Waller in searching for such locations. We will keep you informed of progress.

WBJ:evb
Attach.

AR200074

PHOTO PRODUCTS DEPARTMENT
Newport Plant 81,ESd

CC: W. B. Jennings III ORIGINAL (Red)
L. S. Smith

June 13, 1968

TO: ALL MAGNETIC TAPE PERSONNEL

FROM: MAURO CHIAVERINI

DISPOSAL OF WASTE MATERIALS AND HOUSEKEEPING OF OUTSIDE AREAS

To comply with Newport Plant waste disposal regulations and to maintain a high level of housekeeping standard in our "outside" areas these procedures must be followed:

1. Cigarette butt cans located in "outside" areas are to be used for disposing of cigarette butts. Papers and other waste should not be deposited in these cans.

2. Efforts are necessary in separating materials going to the Newport Plant dump from MDF. All MDF scrap materials are to be separated into three types of scrap. These are:

   a. All scrap magnetic tape is to be put in polyethylene bags to prevent the tape from being scattered over the outside areas. These bags of tapes are to be disposed of in the Dempster Dumpster marked for "Trash Tape Only".

   b. All items that have come in contact with CrO_2 dispersion and/or solvent will be disposed of in empty Lever Paks located in a designated roped-off area on the south side of A-212. Examples of these items are: Texwipes and Nainsook rags used for cleaning up dispersion. (These items should have been deposited in red safety trash cans prior to their being removed to the lever paks; 2. spent filter elements; and 3. small amounts of dispersion, etc.

   c. All other items are to be disposed of in the Dempster Dumpster marked for "Trash Only". Examples of these items are: 1. cardboard boxes and other paper product items; 2. wood items, etc.

The Dempster Dumpsters are to be taken to the Plant dump every scheduled working day. The lever paks are to be taken to the dump, preferably after each shift, but should depend on the fullness of them.

AR200075

Parking of cars in such a manner than blocks access to removal of the Dempster Dumpster to the Plant dump must be discontinued.

MC/bcm

PHOTO PRODUCTS DEPARTMENT
Newport Plant

ORIGINAL (Red)

CC: E. L. Rodowskas
R. M. Salemi
E. H. Kolb
L. S. Smith
M. Chiaverini
Dr. Waller

June 28, 1968

TO: W. E. STUEFER

FROM: W. B. JENNINGS

DISPOSAL OF SCRAP MAGNETIC TAPE
(Ref. your letter of 5/31/68 to W. B. Jennings)
(Ref. your letter of 6/11/68 to L. S. Smith)

Your letter of 5/31/68 requests more complete segregation of chromium containing waste from the Magnetic Tape area to permit proper disposal at the plant dump. While such segregation has been our previous practice, we have re-emphasized this fact to all personnel and we will follow-up to insure compliance. Our practice is summarized in the attached letter from M. Chiaverini.

We have investigated the possible use of a baler to reduce the bulk volume of scrap tape. High spot cost is $5-6000 without building.

Your letter of 6/11/68 requests that we consider off-plant disposal locations for chromium containing waste. We have requested the assistance of Dr. Robert Waller in searching for such locations. We will keep you informed of progress.

WBJ:evb
Attach.

AR200076

PHOTO PRODUCTS DEPARTMENT
Newport Plant

CC: W. B. Jennings III
L. S. Smith

June 13, 1968

TO: ALL MAGNETIC TAPE PERSONNEL

FROM: MAURO CHIAVERINI

DISPOSAL OF WASTE MATERIALS AND HOUSEKEEPING OF OUTSIDE AREAS

To comply with Newport Plant waste disposal regulations and to maintain a high level of housekeeping standard in our "outside" areas these procedures must be followed:

1. Cigarette butt cans located in "outside" areas are to be used for disposing of cigarette butts. Papers and other waste should not be deposited in these cans.

2. Efforts are necessary in separating materials going to the Newport Plant dump from MDF. All MDF scrap materials are to be separated into three types of scrap. These are:

   a. All scrap magnetic tape is to be put in polyethylene bags to prevent the tape from being scattered over the outside areas. These bags of tapes are to be disposed of in the Dempster Dumpster marked for "Trash Tape Only".

   b. All items that have come in contact with CrO_2 dispersion and/or solvent will be disposed of in empty Lever Paks located in a designated roped-off area on the south side of A-212. Examples of these items are: Texwipes and Nainsook rags used for cleaning up dispersion. (These items should have been deposited in red safety trash cans prior to their being removed to the lever paks; 2. spent filter elements; and 3. small amounts of dispersion, etc.

   c. All other items are to be disposed of in the Dempster Dumpster marked for "Trash Only". Examples of these items are: 1. cardboard boxes and other paper product items; 2. wood items, etc.

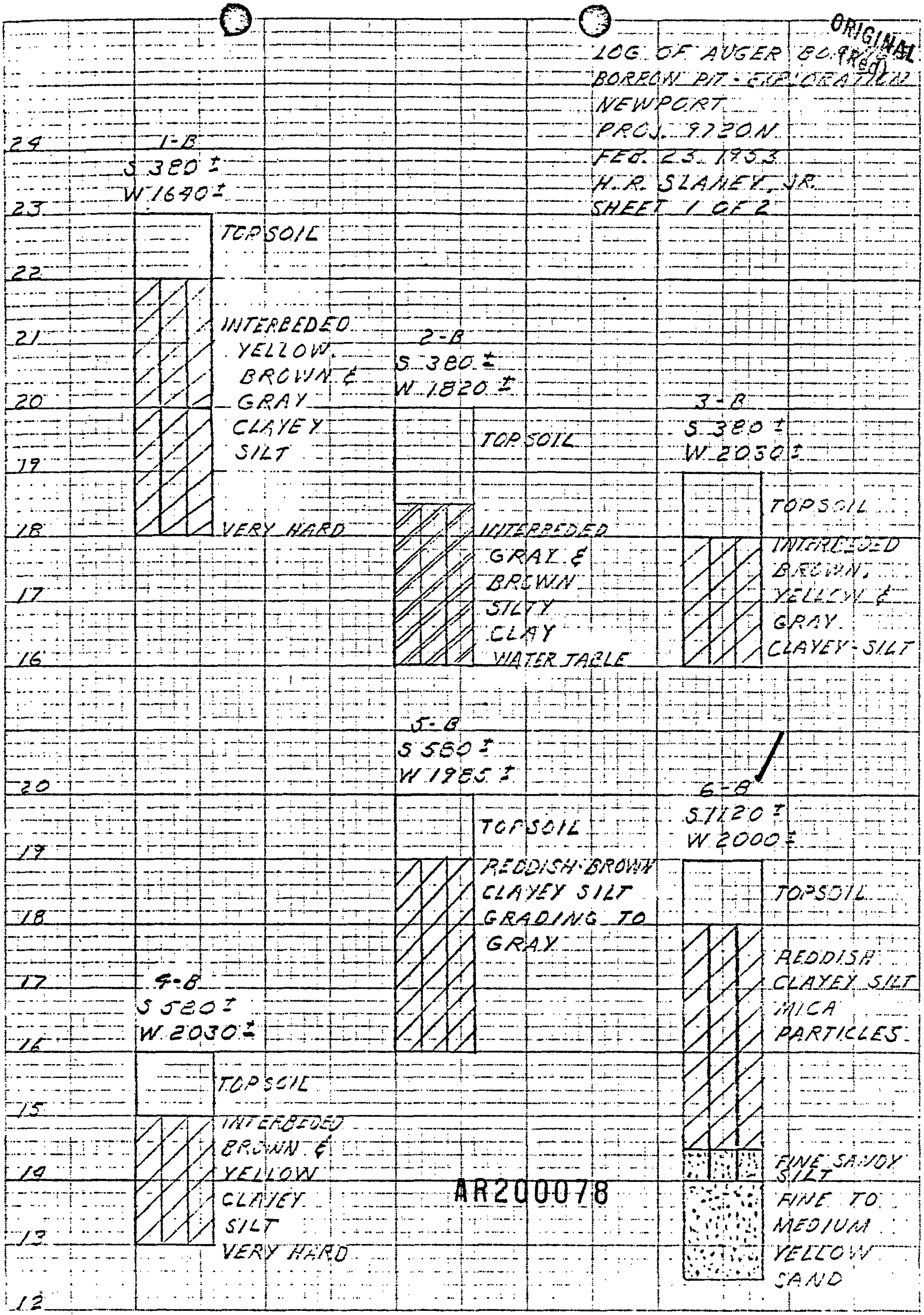
The Dempster Dumpsters are to be taken to the Plant dump every scheduled working day. The lever paks are to be taken to the dump [illegible] after each shift, but should depend on the fullness of them.

Parking of cars in such a manner than blocks access to removal of the Dempster Dumpster to the Plant dump must be discontinued.

AR200077

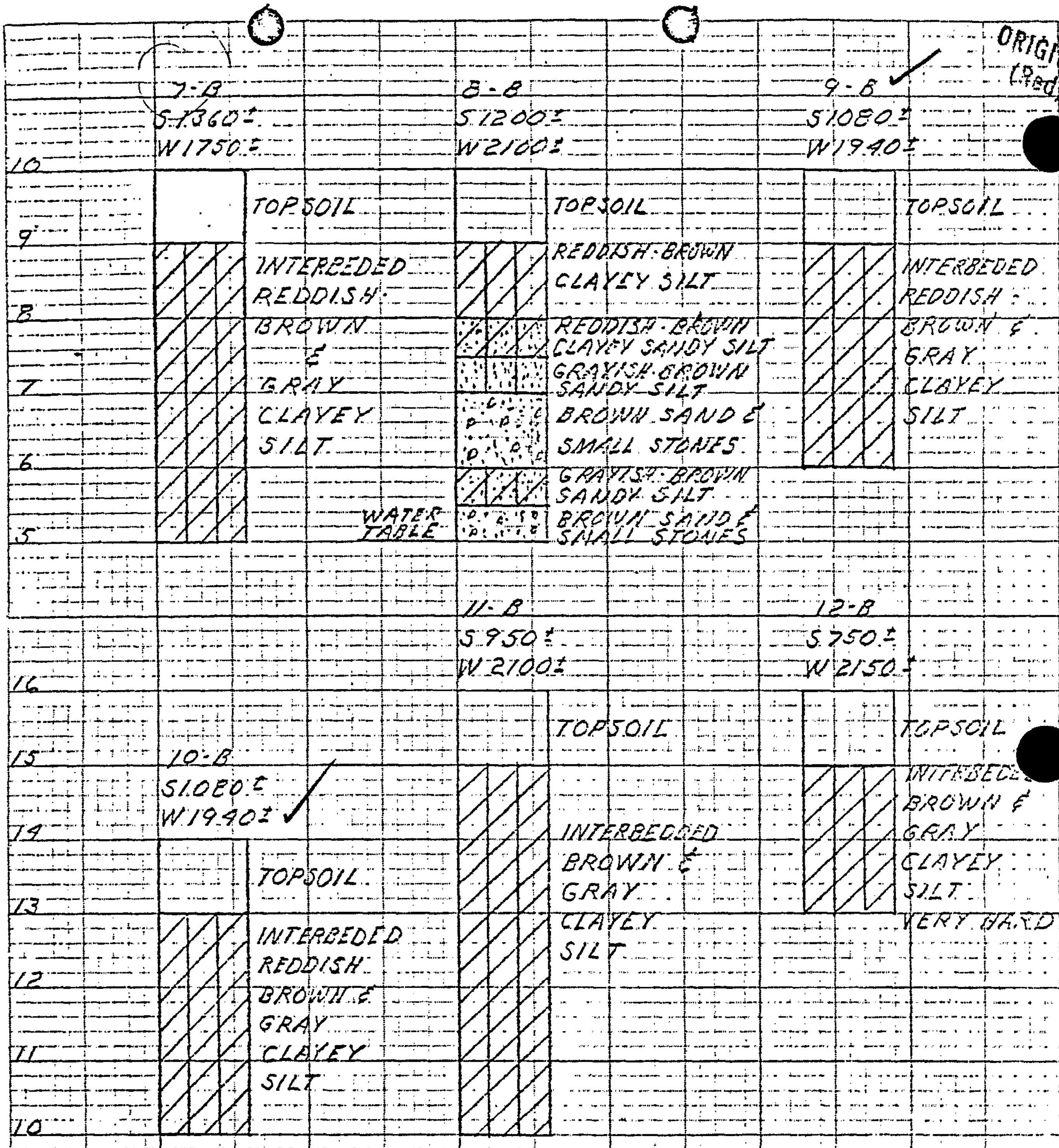
ORIGINAL (Red)

LOG OF AUGER BORINGS
BORROW PIT - EXPLORATION
NEWPORT
PROJ. 9720 N.
FEB. 23, 1953
H.R. SLANEY, JR.
SHEET 1 OF 2



AR200078

ORIGINAL (Red)



LOG OF AUGER BORINGS
BORROW PIT EXPLORATION
NEWPORT
PROJ. 9720-N
FEB. 23, 1953
H.R. SLANEY, JR.
SHEET

AR200079